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The Research Department.

THE sixth Report of the Committee for Scientific and Industrial Research,[1] which was recently issued, deals with a number of matters of scientific importance. It seems but a short time since the establishment of the Department, described in the pages of NATURE for May 20 and July 29, 1915, or the deputation to Lord Crewe, at which the promise of the million fund for the endowment of industrial research was made, and Sir J. J. Thomson pointed out the importance of fostering research in pure science, which, as he said, might lead to a revolution of methods, while from industrial research we could only hope for a reformation of details in method or procedure.

The Report before us naturally falls into three sections: (1) The report to his Majesty in Council of the Committee of Council; (2) the report to the Committee of Council of their Advisory Council; (3) details of the work of the various research boards and committees established under the scheme, including a list of publications both of the Department and of individuals in receipt of grants.

The Committee of Council, like the Board of Trade, has a somewhat shadowy existence. The only names which appear in the Report are those of Mr. A. J. Balfour, the Lord President, and Sir Frank Heath, the secretary. A list of the original Committee is given in the White Papers issued by Mr. Arthur Henderson when President of the Board of Education in 1915 (NATURE, vol. 95, p. 604). Since that date the direct connection between the Committee and the Board of Education has been severed.

The Report to his Majesty is naturally a somewhat formal document; it gives details of the expenditure in various directions—*e.g.* there are now twenty-six research associations, and the total expenditure in grants to these was 74,557*l.* 1*s.* 2*d.*; the balance of the million fund unexpended at March 31 was 903,205*l.* 8*s.* 10*d.*, but it is stated that "of this sum a large percentage has already been earmarked for prospective commitments to associations already formed." In view of the financial stringency, it was arranged last year that a considerable portion of the income from this fund should be appropriated in aid of the vote of the Department. The amount so utilised was about 38,000*l.* This is an arrangement which, in present circumstances, may be necessary, but is not desirable.

Turning now to (2), the Report of the Advisory Council, it is of interest to repeat from the White Paper already quoted the primary functions of the Council. They are to advise the Committee of Council on:

(i) Proposals for instituting specific researches.
(ii) Proposals for establishing or developing special institutions or departments of existing institutions for the scientific study of problems affecting particular industries and trades.
(iii) The establishment and award of research studentships and fellowships.

To these must be added another important matter, outlined in last year's Report, which has taken effect during the year under review, viz. the establishment of co-ordinating boards to organise work which is of common interest to the fighting Services of the Crown. In addition to co-ordinating the work in the various Departments, it is the duty of the boards "to arrange for researches for which inadequate provision is made."

Four boards have been appointed to deal respectively with chemistry research, engineering research, physics research, and radio research. They comprise representatives of the Services and independent men of science, and an interesting account is given of their work, "which, up to the present, has been that of preparation rather than of achievement." The task before the boards is not an easy one; in most cases they can only give advice, though where a research is financed by a board they have more power, and success depends on the friendly co-operation established between the board and those in charge of the work at the various departmental laboratories. The officers of the boards are fully aware of this, and the relations which have been established are thoroughly satisfactory.

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[1] Report of the Committee of the Privy Council for Scientific and Industrial Research for the Year 1920–21.

Turning now to the research associations established under clause (ii) of the original scheme as special institutions "for the scientific study of problems affecting industries and trades," there are, as has already been stated, twenty-six of these. The Report gives an account of the work of some, and of these perhaps the most important is the British Cotton Industry Research Association shortly to find a permanent home at Didsbury, near Manchester. Its programme of research directs attention to two possible lines of advance:

> "(1) To attack problems directly by methods based on past experience without seeking to investigate the fundamental nature of the process.
>
> "(2) To try to understand the chemical and physical changes produced during manufacture, and so to establish gradually a broad roadway along which future advances may be made."

The Cotton Association proposes to seek the advance of the industry mainly by the second line. Its directors have realised the necessity of fundamental research, a matter to which we return below, but this recognition is apparently not shared by all the associations, for a warning given in the last Report against the short-sighted policy of confining research associations to the search for results of immediate commercial value is repeated.

The actual results achieved by the twenty-six associations are somewhat meagre, but three years, the time which has elapsed since the first was founded, is too short a period in which to expect much of fundamental value. The Council point out that it is premature to look to the research associations yet for convincing proof of the effectiveness of co-operative industrial research, and with this view there will probably be general agreement. Still, there are difficulties to be surmounted. Among them one discussed at one of the conferences of associations held at the Department is of great importance: To what extent may an association undertake for its members work of a kind hitherto carried out by the professional analyst or testing engineer? The view was urged by some that consulting work was of definite value to the progress of research, while another association felt that research should only be carried to the initial stage of practical application, the individual firms being left to work out the method of applying the new knowledge to their own particular problems. On this point one may ask the question, Can they do it? Much depends, no doubt, on the problem; in any industry there are probably a number of large firms with their own scientific staffs who have ample opportunity for working out the details of a new process, and it is likely that this can be done to greater advantage in the works than in the research association laboratory. But this does not apply to the small firms to be found in large numbers in any industry, which, if the association is to benefit the trade, must be brought in and given the means of utilising the results. Experience shows that a process has to be carried a long way before it can be usefully applied by such firms, and while this is not the same as undertaking consulting work, it must be carried out at the laboratory of the association. It will be found, no doubt, in the long run, that no rigid rule can be laid down. Each association must work out for itself the problem of combining pure research with industrial practice.

This naturally leads to a consideration of the steps the Council is taking to encourage pure research dealt with under (i) and (iii) of the original scheme, though, did space permit, much more might be written about the work of the other committees and boards of the Department. Encouragement is given (*a*) by financing specific researches carried out by competent men, and (*b*) by research studentships. The applications for grants are divided into those (1) for students in training, (2) for research workers or research assistants, (3) for laboratory or clerical assistants, and (4) for equipment.

The applications numbered 333 in all, of which 245 were granted, 36 refused, and 52 referred elsewhere. Of the 245 granted, 132 went to students in training and 70 to research workers or assistants; of the 132 students in training, 95 are engaged in chemical work, but comparatively few of these, we may surmise, are doing fundamental research; they have not yet reached the stage at which this is possible, being still "in training"; some few may in time become research workers and add to the stock of fundamental knowledge. Further details are given in appendix 2, while in appendix 3 we have a list of aided researches; scarcely one of these deals with work in pure science; they include glass technology, the corrosion of condenser tubes, the flow of steam through nozzles, and other similar investigations of an industrial character. An exception should be made in the case of the work on tides now in active progress at Liverpool University, but here, too, the results have a direct industrial bearing. On the other hand, appendix 4—publications by individuals in receipt of grants—does contain a number of papers of the greatest importance to pure science—*e.g.* Dr. F. W. Aston on "Mass Spectra and Atomic Weights"; Sir Ernest Rutherford, "The Nuclear Constitution of Atoms" and "The Mass of the Long-range Particles from Thorium-C," with many others of less striking merits—while an interesting list is given on p. 73 showing the wide range of science covered by the papers. It appears that during the year under review a sum of 40,850*l.* was spent on these grants, while provision is made for the expenditure of 50,000*l.* during the current year, but by no means all of this was for the advancement of pure research, and the criticism may be made that, compared with the amounts available for industry, the sum devoted to pure research is but small.

Yet it is difficult to see how it could be greatly different. The men capable of original research in pure science are limited in number. We have long known that *Poeta nascitur non fit* and poetry and original discovery have much in common. Imagination of a high order, combined with skilled training and a real grasp of essential principles, the love of knowledge for its own sake, the readiness to pursue it whithersoever it may lead, and the opportunity to do this when the exceptional man is found, are all required. The opportunity implies freedom from too much pure routine and financial worries. The best course the Advisory Council can adopt is to see that all those who have shown the incipient signs of this ability should have the opportunity and the freedom. The Council realises this in theory; it was pointed out in the Report for last year that "no conditions are attached to the grants made to workers whose sole aim is the extension of knowledge either as to the line of their work or as to the use to be made of their results." If a discovery is to be made use of commercially, application must be made to the Department.

This is as it should be, but it is almost equally important that the same principle should apply to work done for the research associations or in the various laboratories controlled or aided by the Department. It is impossible to evaluate pure research on principles which apply to a works, or even to a works laboratory engaged mainly on routine testing and the examination of products. There is a real danger lest the time of men thoroughly competent to carry out fundamental investigations of high value should be absorbed in serving tables, in compiling details of the hours and minutes spent on this or that job, or in writing minutes in reply to official inquiries. It is difficult, no doubt, for a Government Department to avoid this; there are Treasury rules to be followed, but the error comes in the attempt to apply these rules to conditions for which they were never intended.

It should be noted, however, as the Council itself points out, that the funds which it administers in grants to workers mainly at the universities are only a small portion of the sum contributed by the State through other agencies to university education and research. It is not the business of the Council to pay professors and teachers. It can make grants only for individual pieces of work, and this function we may fairly hope it will discharge when once convinced of the importance of the work and the capacity of the worker, with a broad faith and without too narrow an inspection of details.

The Report covers much ground, and much more could be written about it, but space forbids. One matter, however, mentioned at the end, must be noticed. The results of research become known through the publications of the scientific societies, and many societies are in a difficult position financially, and find it impossible to make both ends meet. The matter has been considered by the Conjoint Board of Scientific Societies, but it moves slowly; still, it is intended that a statement of the case should be presented in the near future to the Treasury. The Council had referred to the matter in the Report for last year, and it now states:

"We have learned with satisfaction that action has already been taken by the scientific societies on the lines suggested in our Report of last year, and should they apply for, and receive, Government aid through the Treasury under a well-thought-out scheme, we should welcome the removal of a serious obstacle to the progress of science in this country."